NOAA's Space Weather Plans

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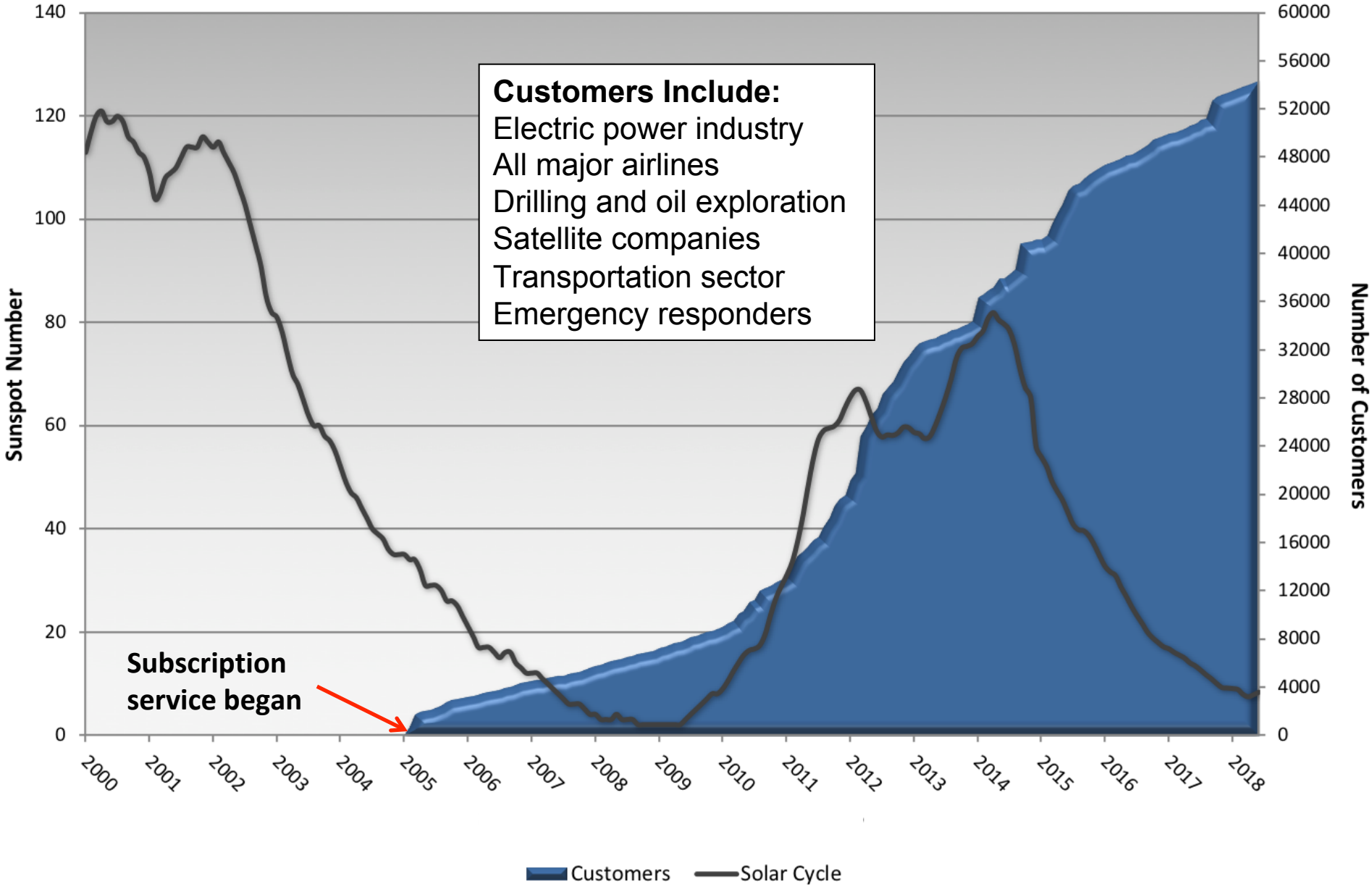
NOAA Space Weather Prediction Center

Main Points

Goal: Provide information (forecasts, nowcasts, retrospective) that enables economically important decisions

- Space weather product demand is increasing
- Applied research efforts are expanding
- Observational infrastructure is improving – government, private industry, and international

Customer Growth
NOAA Space Weather Prediction Center – Product Subscription Service



Impacts on Critical Infrastructure - Economic Impact Study

FINAL REPORT

Social and Economic Impacts of Space Weather in the United States

September 2017

Abt Associates
Bethesda, Maryland

Written under contract for the NOAA National Weather Service
www.nws.noaa.gov

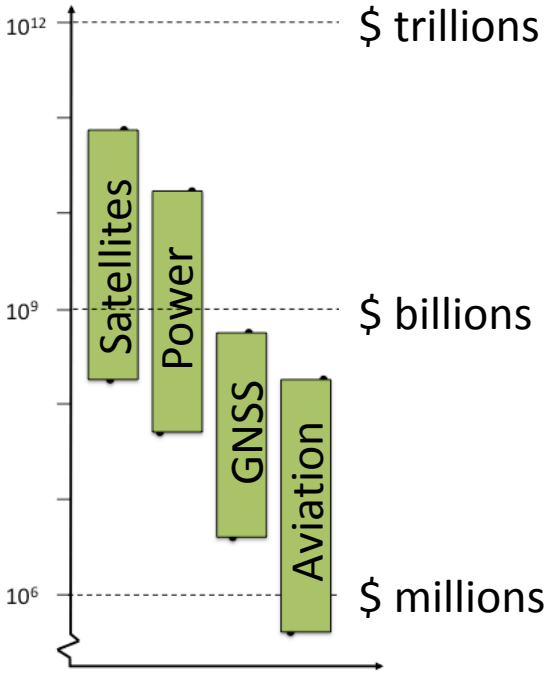
www.weather.gov/news/171212_spaceweatherreport

Source: Stacey Worman, Abt Associates

Key Findings

- Impacts are a real concern
- Stakeholders are interested
- Topic is complex
- Mitigation may be inexpensive
- Help value NOAA investments

Estimated cost of moderate/extreme event



Note: Costs represent first pass estimates not to be taken out of context or quoted without appropriate caveats. Qualitative information and quantitative framework are the more important contributions of this effort.

Space Weather Applications Research

Goal: Measurable near-term improvement to enable economically important decisions

New approach to connecting research and services:

- Targeted focus
- Flexible implementation
- Responsive to evolving priorities and capabilities

Full integration of multi-agency capabilities:

- Economic impact and user requirements surveys
- Research-to-operations and operations-to-research funding
- Community Coordinated Modeling Center

Applied Research Funding

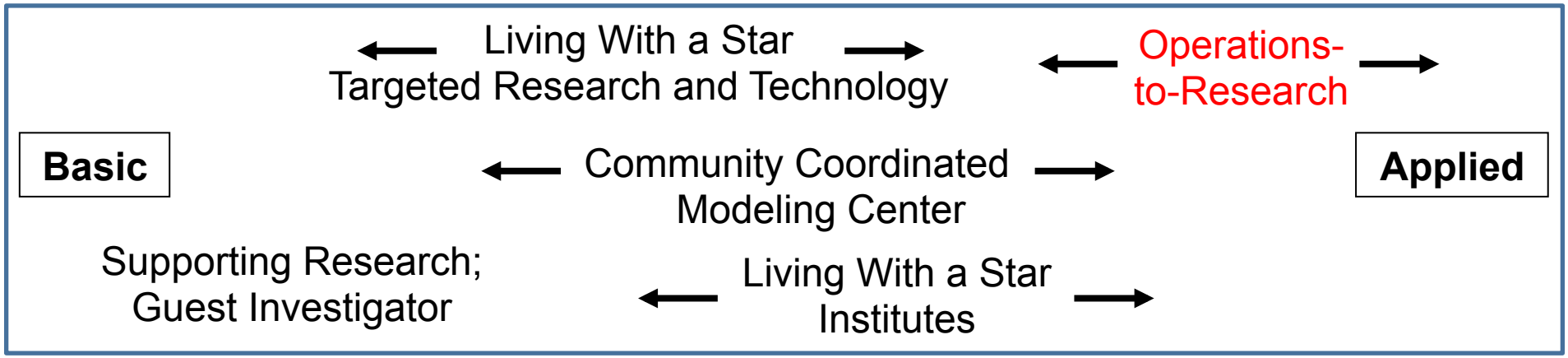
Pilot funding for Operations-to-Research proposals:

- Improve predictions of the background solar wind, solar wind structures, and CMEs
- Data assimilation and machine learning encouraged
- Proposals were reviewed June, 2018

Improve specifications and forecasts of energetic particle and plasma encountered by spacecraft:

- Definition of products required
- Definition of metrics and validation methods required
- Industry participation strongly encouraged
- Proposals were reviewed September, 2018

Heliophysics Research and Space Weather



- Funding opportunities are now available across the spectrum from basic to applied research
- Challenge is to enhance and evolve the research-community participation in applied research and have all elements work synergistically

Horizon 2020 - Space Weather

Goal: Forecasting space weather 10s of hours to days in advance

- Develop modeling capabilities
- Develop prototype services
- Identify indicators of extreme events
- Application domains include space and terrestrial infrastructure
- Open to international partners

Under discussion: Workshop on U.S.-Europe collaboration on space weather research

- Sunday afternoon prior to Fall AGU (December 9, 2018)

DSCOVR

- Launched: February 11, 2015
- Replaced operational use of NASA ACE spacecraft
- Space weather measurements:
  - Solar wind density, velocity, temperature
  - Solar wind magnetic field
- High-reliability warnings of geomagnetic storms
- Requires international real-time data network

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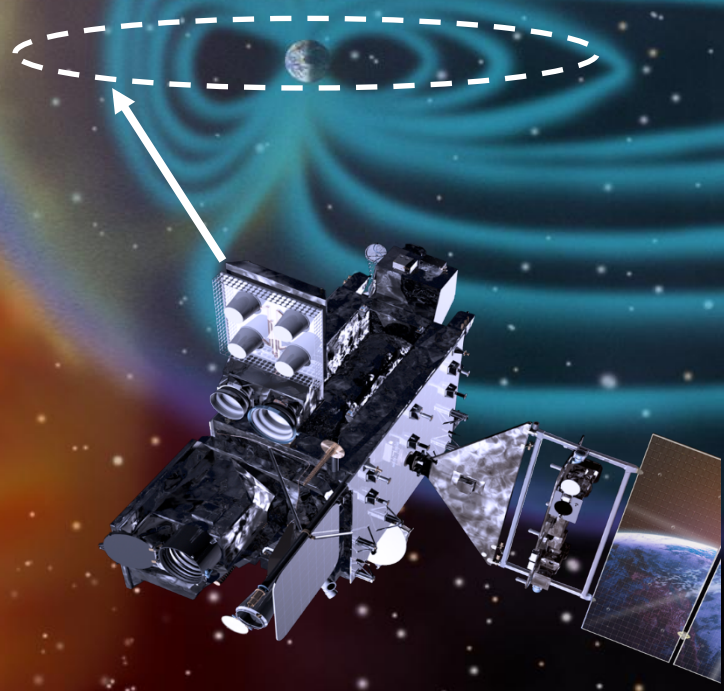
Plans for L1 Space Weather Follow-On

Long-term continuity of key L1 and coronagraph measurements

1. Building two compact coronagraphs (CCOR)
2. Hosting the first CCOR on NOAA's GOES-U spacecraft planned for launch in early 2024
3. Procuring through NASA, a SWFO L1 satellite mission to carry a Solar Wind Instruments Suite (SWIS) and a second CCOR.
4. Building and operating a robust system to receive and process space weather observations.
5. Partnering with ESA for observations from L5 and with the USAF for energetic particle measurements.

Geostationary Operational Environmental Satellite Series GOES-16 and GOES-17

- Launched:
  - GOES-16: November 19, 2016
  - GOES-17: March 1, 2018
- Space weather measurements
  - Solar Ultraviolet Imager (SUVI) – Full-disk extreme ultraviolet imager
  - Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)
  - Space Environment In-Situ Suite (SEISS): Electrons, protons, heavy ions
  - Magnetometer



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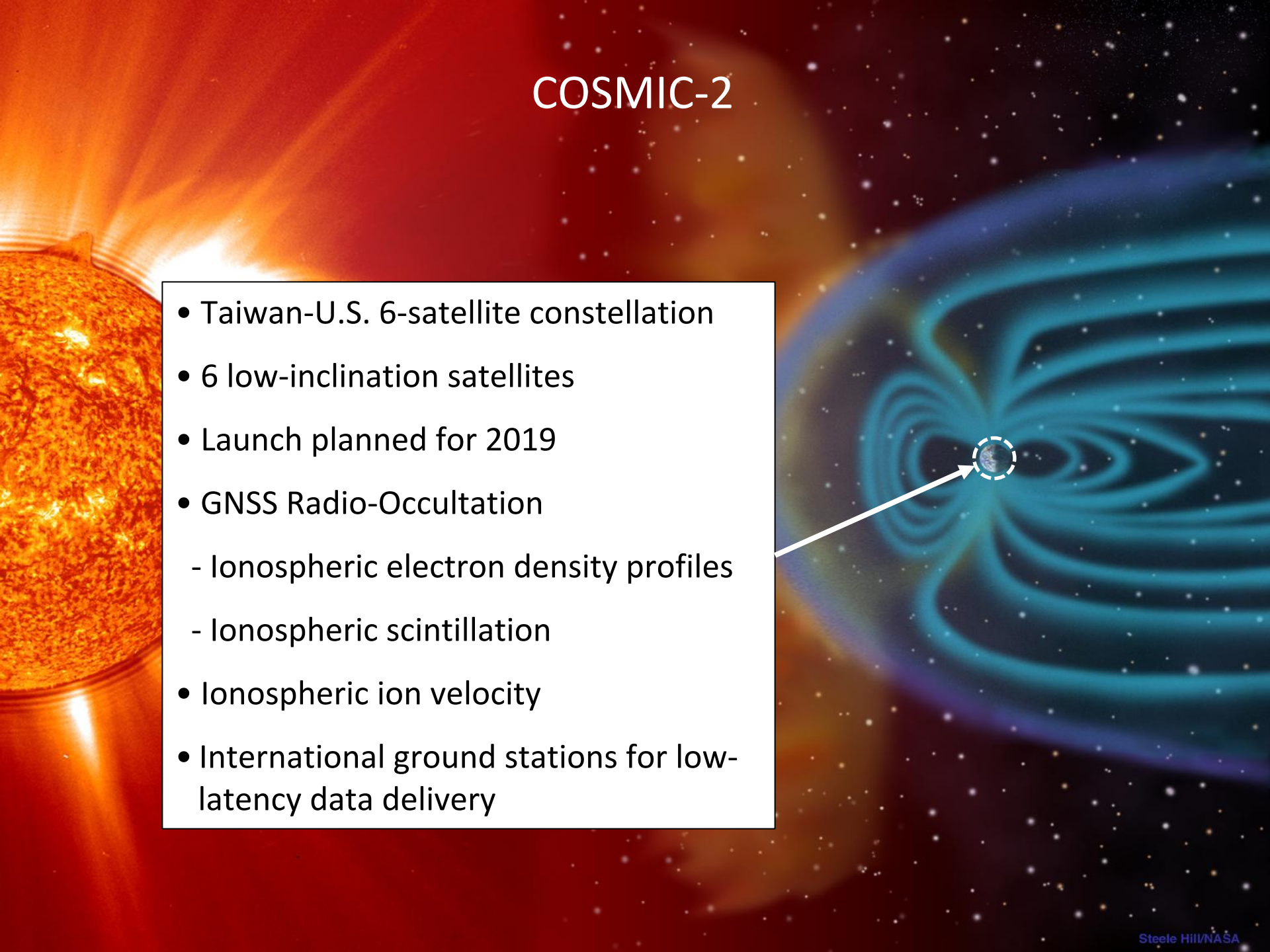
COSMIC-2

- Taiwan-U.S. 6-satellite constellation
- 6 low-inclination satellites
- Launch planned for 2019
- GNSS Radio-Occultation
  - Ionospheric electron density profiles
  - Ionospheric scintillation
- Ionospheric ion velocity
- International ground stations for low-latency data delivery

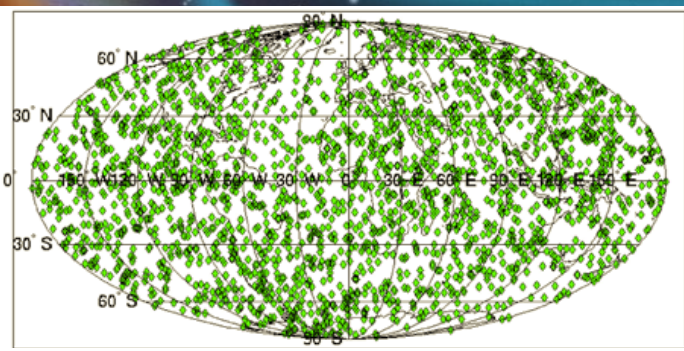


Office of Space Commerce

Helping U.S. businesses use the unique medium of space to benefit our economy

NOAA Awards Commercial Weather Data Pilot Round 2 Contracts

- Contracts awarded September 17, 2018
  - GeoOptics, Inc.
  - Spire Global, Inc.
  - Space Sciences and Engineering, LLC
- Companies provide GNSS radio occultation measurements of upper atmosphere and ionosphere
- NOAA evaluates suitability for operational weather and space weather products



The Dream

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International Organizations Engaged in Space Weather Services

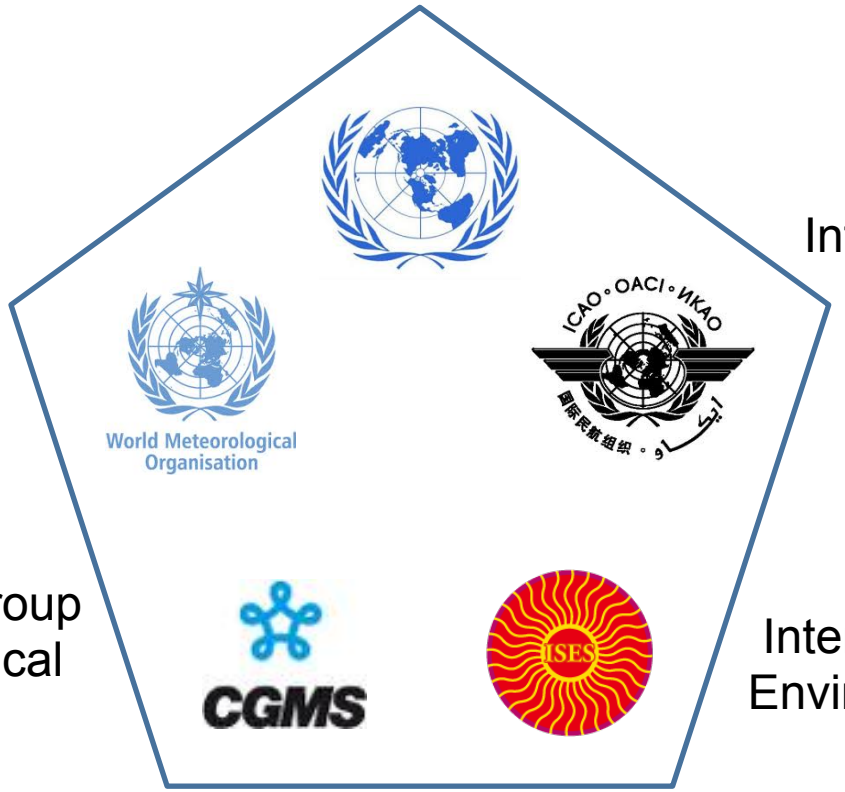
UN Committee on the Peaceful Uses of Outer Space

World Meteorological Organization

International Civil Aviation Organization

Coordination Group for Meteorological Satellites

International Space Environment Service



Numerous other groups are active in space weather research (COSPAR, ISWI, ILWS, IAU, URSI, SCOSTEP, etc.)

Summary

- Demand is increasing for space weather services – electric power, aviation, satellites, navigation, communication
- Interest is increasing among industry and users of space weather information
- Research funding is becoming available to address applied topics
- Space-based observing infrastructure is improving
- International focus is growing on space weather applications
- Question: How do we coordinate the national and international effort to demonstrate measurable, near-term improvement in needed services?